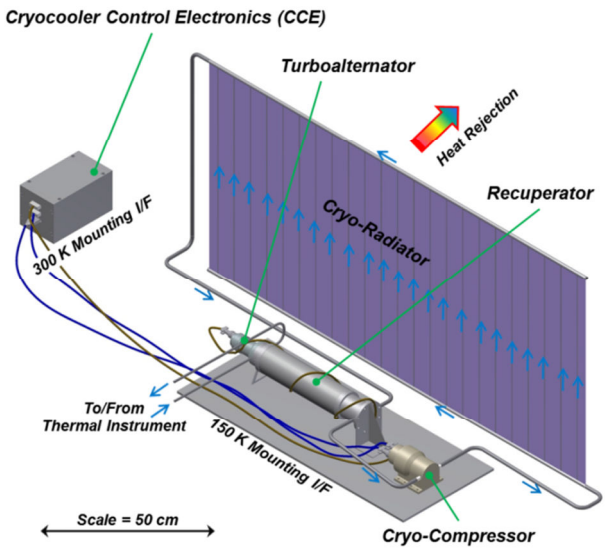
An Ultra Low Power Cryo-Refrigerator for Space
Contract No. NNX11CE86P

PI: Dr. Mark V. Zagarola
Creare Incorporated, Hanover, NH

Identification and Significance of Innovation
On this program, Creare proposes to develop and demonstrate an innovative cryocooler that produces refrigeration at temperatures of 30 to 70 K and rejects heat at a temperature of 150 to 210 K with extremely high efficiency. The heat rejected can be absorbed by an upper stage cryocooler or rejected to space through a small cryo-radiator. The overall mass of the cryocooler, cryo-radiator and electronics is nominally 6 kg, the area of the cryo-radiator is 0.8 m^2 and the input power is significantly less than current state-of-the-art cryocoolers. The electronics utilize parts that are tolerant to 300 kRad total ionizing dose. In addition, the cryocooler technology is extremely reliable and scalable, and produces no perceptible vibration.

Expected TRL Range at the beginning and end of Contract (1–9): 4 to 5



Ultra Low Power Cryo-Refrigerator for Space. Cryocooler was optimized to produce 300 mW of refrigeration at 35 K with 9 W of compressor power.

Technical Objectives and Work Plan
On the proposed Phase II project, we will build and test a demonstration cryocooler and cryo-radiator. The demonstration system will include a combination of new and existing components. The Phase II testing will be structured to achieve a TRL of at least 5, and will include cryogenic performance testing and launch vibration testing. The cryocooler would be space-qualified during a follow-on Phase III project.

NASA Applications
Applications include future satellites, probes and astronomical observatories utilizing superconducting bolometers, and infrared, far infrared, submillimeter and X-ray detectors. NASA missions include the Jupiter-Europa Orbiter (JEO), Wide Field Infrared Survey telescope (WFIRST), Single Aperture Far-IR (SAFIR) telescope, Space Infrared Interferometric Telescope (SPIRIT), Submillimeter Probe of the Evolution of Cosmic Structure (SPECS), and the International X-Ray Observatory (IXO).

Non-NASA Applications
Military space applications include space-based surveillance for Operationally Responsive Space missions.

Firm Contacts
Mark V. Zagarola, Principal Investigator
603-640-2360; mvz@creare.com
Sheryl D. Belanger, Contracts Manager
603-640-2341; contractsmgr@creare.com